

year, and with about the same degree of richness, precisely as in the case of the August meteors, or Perseides, whence we can understand the great interest attaching to the study of these objects during the next few years, for the purpose of tracing the law according to which the progressive diminution of these displays proceeds, especially if we remember (as Prof. Schiaparelli, of Milan, has pointed out to me), that a fine shower was observed in 1818, that is to say, nearly midway between the great displays of 1799 and 1833.'

A General Comparative Table of Radiant-Positions and Duration of Meteor-Showers. By R. P. Greg, Esq., F.R.A.S.

The accompanying Table of Radiant-Positions and Epochs of Meteor-Showers is intended to show at a glance the comparative results of all the meteoric showers whose centres of radiation, in right ascension and north declination, and whose epochs have hitherto been approximately or definitely ascertained. The recent increased interest attached to meteoric science since Professor Schiaparelli's discovery of the intimate connexion between the orbits of comets and meteor-rings renders it most desirable that the scattered and laborious researches of various observers and collators should be brought together and synoptically arranged. This I have endeavoured to do in as brief and simple a manner as possible. Having due regard to the nature of the case, there results a greater amount of coincidence and resemblance than might have been expected from the reductions of nearly 6000 observations, independently of Leonides and Perseides, made by different observers in different countries, recorded during the last twenty years. Indeed the results are frequently remarkably coincident, when we consider how difficult it is to arrive, even in the case of the more frequently observed and better known Leonides and Perseides, at a precise radiant-point. It is even less simple to ascertain with anything like precision the extent and configuration of the radiant area when, as is frequently the case, it more or less diffusely occupies a region amongst the stars of some 10° or 20° in diameter. In some cases it is highly probable that the area is simply "diffuse;" in others it probably includes a series of minor or sub-radiants (the existence and origin of which have been ingeniously, and perhaps correctly, explained by Signor Schiaparelli*), and of whose existence I had myself expressed a suspicion, some years ago, in the Report of the British Association for 1868-9. The probability of the existence, also, of meteoric showers having a duration of some six weeks appears to be still further confirmed by the comparative table or catalogue now presented. (See *Proceedings of the British Meteorological Society* for January 1865.) Professor Heis (see the *Astronomische Nachrichten*, April 1867) was the first systematically to attempt to group and arrange centres of

* See the Report of the British Association Committee on Luminous Meteors, 1871.

radiation for meteor-showers, as deduced from a series of many hundreds of observations recorded and mapped by himself and pupils at Münster, in Westphalia; but he did not attempt to fix the exact duration, or radiant-position, of individual meteor-showers, or the relative importance of the different meteoric systems. Messrs. Greg and Herschel attempted to do this more systematically, both from special observation and by a reduction of some 2000 meteors recorded in the annual Meteor Reports and Catalogues of the British Association (see the vols. of the British Association Reports for 1864, and 1868-70). The results were also laid down in a series of 22 folio plates upon an atlas of the stars gnomonically projected. In addition, a number of new radiants were also determined by myself, deduced from some 700 Italian observations observed and described by Signors Zezioli, Denza, and Serpieri, during the years 1868-1870; and many of the English ones were found to be fairly well confirmed by the Italian observations. The catalogue of meteor-radiants lately published by Schiaparelli, chiefly and specially deduced from some 900 (out of nearly 7000) observations made in the course of three years, 1867-1869, by the late indefatigable observer Signor Zezioli, of Bergamo, was drawn up with the more special view of tracing out the specific centres of radiation of various separate or identical meteor-showers, and their possible daily alterations of position. The result seems frequently to confirm a number of the radiants of Professor Heis and of Messrs. Greg and Herschel, and to indicate more clearly the probable occurrence of subordinate or multiple radiant-points belonging to one and the same meteor-system. (See the British Association Reports, 1871, p. 44, *et s. q.*) It may also be here noted that the Italian observations, generally more consecutively and regularly conducted, include, necessarily, a far larger proportion of small meteors, of 4th and 5th magnitudes, than could be the case with the English and German ones; and also that, though including a greater number of probable meteor-showers of minor and secondary importance, these nevertheless possess features of much scientific interest. Probably the catalogue of radiants given by Messrs. Greg and Herschel show best the general positions, epochs, and durations of the more prominent showers; but much has yet to be done, doubtless, in more precisely and accurately determining those features. The very considerable number of centres of radiation, combined with the frequent, and evident tendency to width and diffuseness in some of the radiant areas themselves, combine to make the reductions and grouping of the paths, or meteor-tracks, for any single radiant, on celestial maps especially constructed for the purpose, often a matter of considerable complexity and difficulty. Mr. Greg thought at first that there was a not unfrequent tendency, in long-enduring showers, to give a radiant advancing with the time among the stars; but though, undoubtedly, the radiant area frequently appears to have an elongated form, further investigation does not seem to bear out that idea. Possibly the radiants M 6, 7, M 7, 8, S 5, 6, 7, 8, however, are exceptions. Signs of elongation of the radiant area

are considered by Mr. Greg, Signor Serpieri, and Professor Newton to be more or less plainly noticeable in the principal meteor-showers of August, November, and December. Some short-lived showers, or those having days of special maximum, as K 1, 3, O, L (the November shower), and Q H 2, however, appear to have a very fairly precise centre of radiation. The radiant points by Prof. Schiaparelli are those given by Dr. G. von Boguslawski, of Stettin, in his recent German publication of a new edition (considerably enlarged by the author), of Schiaparelli's work on the *Astronomical Theory of Shooting Stars*. The 189 radiants there given are, in this Table of Comparisons, reduced by grouping to 79, and the grand total of the radiants now presented is 132. It is, however, probable that a certain number of these are either pseudo-centres or require further confirmation or correction. In some cases, probably, the truest radiant-positions may be found in a more or less nearly average position of those given by two or three of the catalogues now for the first time fully and systematically tabulated and arranged together. In several cases, as with U, B 5, R G, E 2, Y, H, of Greg and Herschel, some of them representing very well-marked and important meteor-showers, the position and epoch given by Greg and Herschel are certainly more accurately placed and determined than those of their counterparts in the other lists. For certain showers, as L, A 10, Q H 1, V, T 1, Q H 2, O, G 1, K 1, 3, A G 1, S 4, S G 2, U, F 1, 2, L H, &c., there are pretty well established days of maximum frequency, giving meteors more or less characteristically distinguished from those of other showers. Some of these distinctions or peculiarities have been attempted to be given with the Atlas published by Messrs. Greg and Herschel for the British Association in 1868, but more observation specially directed to these points is required. It is yet too early to attempt to give results of a comparison of the list of radiant-points with the orbits of comets; but it is well known that some successful attempts in this direction have been already made by Schiaparelli, Weiss, Galle, Newton, and D'Arrest. The first and most important object at present attempted to be gained is to collect all the best observed radiant-positions and epochs of the meteoric showers themselves, and to ascertain, by special and further observation, with as much accuracy as possible, their true positions and durations. With the view to assist these determinations, and to enable observers to arrive at uniformity in the method and arrangement of their results, it is hoped that the accompanying Table will be found to be of some utility, as representing, principally for the northern hemisphere, the limits to which this branch of observations in meteoric astronomy may be briefly and comprehensively described as having at present reached. In most cases positive accuracy is impossible, from the very nature of the case, absolute accuracy of observation of the meteors themselves being unattainable; nor, in many cases, is it probable that the exact average centre of radiation of a number of meteors will be quite similarly determined by two different collators, even from the same series of observations.

A Synoptic or General Table of the Radiant Positions and Duration of Meteor Showers, observed in the Northern Hemisphere, 1872.

	Epoch or Duration of Meteoric Shower.	Average Position of Radiant.		Name or Number of Radiant.	Authority.*	Observations.
		R.A.	N.D.			(N.B. Radiant Area supposed to be 15° in Diameter. Radiants, "Z," by Mr. Greg, from Zezioli's Observations.)
1	Dec. 20—Feb. 26	10°	86°	N G	G. & H.	Radiant elongated 20°, + 88° to 320°, + 80°. Centre 350°, + 87°?
	Dec. 15—Feb. 14	222	87	N 21, 1, 2, 3	Heis	
2	Dec. 27—Jan. 31	130	47	189, 7, 23	S. & Z.	Centre about 135°, + 45° = Comet of 1680? (Weiss).
	Jan. 1—Feb. 9	135	40	M 1, 2	G. & H.	
	Jan. 1-15	145	51	M 1	Heis	
3	Dec. 27—Jan. 29	203	53	{ 1, 6, 12, 13, 16, 18, 21, 188 }	S. & Z.	Radiant multiple.
	Jan. 6-29	200	55	Z 10	G. & H.	
4	Jan. 2-3	238	45	K 1, 3	G. & H.	Corroborated by American observations. A notable meteor epoch, maximum 2nd-3rd Jan.
	Dec. 15—Jan. 15	231	53	K 1, 3	Heis	
5	Jan. 10	10	57	3	S. & Z.	Probable centre near 22°, + 56°.
	Dec. 20—Jan. 30	21	56	A 1, 2	G. & H.	
	Dec. 15—Jan. 31	32	56	A 20, 1, 2	Heis	
6	Jan. 11	47	40	4	S. & Z.	
7	Jan. 6	150	67	G ₂	G. & H.	(Noticed by Mr. Clark, at York, 1872.) Possibly = No. 132.
8	Dec. 22—Feb. 6?	181	35	2, 5, 30, 185, 186	S. & Z.	Radiant area large; multiple; real centre at 180° + 35° = Comet II. 1792? (Weiss). Heis probably incorrect.
	Jan. 1-25	183	36	M G 1	G. & H.	
	Jan. 16—Feb. 1	169	45	M 2	Heis	
9	Jan. 19—Feb. 5	209	25	9, 14, 15, 27	S. & Z.	Radiant multiple?
10	Jan. 27	132	67	17	S. & Z.	Centre about 140°, + 70°?; diffuse, and rather uncertain.
	Jan. 21—Mar. 20?	140	71	M 4, 5	G. & H.	
11	Jan. 28	67	25	19	S. & Z.	Denza found 72°, + 18°.
	Dec. 20?—Feb. 6	65	20	A G 1	G. & H.	
12	Jan. 3—Mar. 16	143	-7	S 1, S G 1	G. & H.	
13	Jan. 9-19	72	4	G ₃	G. & H.	Reduced from Denza's obs. 1868, by Mr. Greg, and confirmed in England.
14	Jan. 19—Feb. 6	242	63	11, 29	S. & Z.	(223°, + 54°, by Mr. Greg, from Denza's observations.) Centre 225°, + 54°.
	Jan. 29—Feb. 6	223	54	K 2	G. & H.	
	Jan. 15-31	227	54	K 2	Heis	

The initials S. & Z., refer to Prof. Schiaparelli and Sig. Zezioli (1867-1870); G. & H., to Mr. Greg and Prof. Alex. Herschel (British Association, 1848-1871); Heis, to Prof. Heis, of Münster (1839-1867). The Nos. under "Name or Number of Radiant," to Boguslawski's Catalogue in the translation into German of Signor Schiaparelli's work on meteors.

	Epoch or Duration of Meteoric Shower.	Average Posi- tion of Radiant.		Name or Number of Radiant.	Authority.	Observations. (N.B. Radiant Area supposed to be 15° in Diameter. Radiants, "Z," by Mr. Greg, from Zezioli's Observations.)
		R.A.	N.D.			
		°	°			
15	Jan. 18—Feb. 13	226	30	{ 8, 10, 20, 22, } 24, 25?, 33	S. & Z.	Radiant multiple; centre 230°, + 32°.
	Jan. 28-29	233	34	Q Z	G. & H.	
16	Feb. 1-14	61	46	A 3	Heis	
17 (34)	Feb. 6	183	56	31	S. & Z.	Probable commencement of M 7 of Heis.
	Feb. 1-28	172	59	M 3, 4	Heis	
18	Feb. 16	74	48	39	S. & Z.	= A Z 3; centre 73°, + 40°. Rad- iant precise.
	Feb. 9-17	73	40	A 3, 4	G. & H.	
	Feb. 15-28	76	40	A 4	Heis	
19	Feb. 6-15	131	52	28, 37	S. & Z.	Requires further investigation. Radiant elongated according to Schiaparelli.
	Mar. 1-15	120	54	M 5?	Heis	
20	Mar. 1-15	50	47	A 5	G. & H.	Confirmed by Italian obs.
	Feb. 1—Mar. 15	50	49	A 5	Heis	
21	Feb. 3	153	21	26	S. & Z.	
	Feb. 4-26	153	35	M 3	G. & H.	
22 (31)	Feb. 10—Apr. 2	175	10	S 2, 3	G. & H.	This series of radiants (S. of Heis) seen by Neumayer in Australia, probably advances from R.A. 175 to R.A. 200, with the time.
	Feb. 15—Mar. 31	177	13	S 1, 2, 3	Heis	
23	Feb. 11-20	194	15	S 2, a	G. & H.	Possibly a continuation of No. 14.
24	Feb. 17-19	238	51	40, 41	S. & Z.	Meteors small.
25	Feb. 13	133	26	32	S. & Z.	Ditto.
26	Feb. 14	105	62	34	S. & Z.	Ditto.
27	Feb. 14	263	68	36	S. & Z.	Ditto.
	Feb. 15-28	245	76	N 4?	Heis	
28	Feb. 14-15	209	52	35, 38	S. & Z.	Ditto.
29	Mar. 1-15	50	49	A 5?	Heis	
30	Mar. 3-25	247	— 3	S Z 1	G. & H.	Possibly commencement of S Z 2.
31 (47)	Mar. 5-17	190	1	S 4	G. & H.	Probable commencement of S 5, 6.
32	Mar. 9-27	74-112	32-47	A Z 1, 2, 3	G. & H.	In part=A 3, 4 radiant contd.? Small meteors obsd. by Zezioli: A Z 1=112°, +32° A Z 2= 98°, +46° A Z 3= 74°, +47°=A 3, 4?
33	Mar. 20—Apr. 25	143	51	43, 61	S. & Z.	
	Mar. 22—Apr. 23	146	46	M Z	G. & H.	
	Mar. 16-31	150	47	M 6	Heis	Central position 148, + 48; per- haps connected with M Z.
34 (17)	Mar. 17	186	56	42?	S. & Z.	
	Mar. 3—Apr. 30	180	60	M 6, 7	G. & H.	Probable continuation of M 3, 4 of Heis. Centre 180, + 50.
	Apr. 1-15	180	49	M 7	Heis	

	Epoch or Duration of Meteoric Showers.	Average Position of Radiant.		Name or Number of Radiant.	Authority.	Observations. (N.B. Radiant Area supposed to be 15° in Diameter. Radiants, "Z," by Mr. Greg, from Zezioli's Observations.)
		R.A.	N.D.			
		°	°			
35 (50)	Apr. 1-23	256	43	{ 46, 49, 50, 51, 57, 60 }	S. & Z.	Multiple radiant. Possibly com- mencement of D G 2. General centre of D G 1, D G 2 = 268, + 51? (See No. 50).
	Mar. 11—Apr. 23	267	53	D G 1	G. & H.	
36	Mar. 27—Apr. 30	224	38	44, 48, 54, 65	S. & Z.	
	Mar. 12—Apr. 30	223	40	M G 2	G. & H.	
37	Mar. 15—Apr. 20	305	27	W Z	G. & H.	
38	Apr. 25	260	24	63	S. & Z.	Prof. Herschel, 13 April, 1864, = 273°, + 25½° = Comet I. 1861? (Weiss). Max. 13th April. R. P. Greg, 20th April, 1872, 267° + 25°
	Mar. 15?—Apr. 23	268	25	Q H 1	G. & H.	
39	Mar. 19?—Apr. 22	277½	34½	Q H 2	G. & H.	Prof. Serpieri (267°, + 35°). Prof. Galle (278°, + 34½°) = Comet I. 1861? (Weiss and Galle). A not- able shower; max. display April 19-22. Q H 1, Q H 2 and C, probably all identical.
	Apr. (20) 15-31	277	38	C	Heis	
40	Mar. 20—May 29	227	-5	S G 2 (S Z 2)	G. & H.	
41	Mar. 25—Apr. 30	290	-10	O Z	G. & H.	More observations required.
42	Apr. 11-29	187	24	53, 64	S. & Z.	
	Mar. 25—Apr. 24	198	32	M G Z	G. & H.	
	Apr. 1-30	192	18	S 4, 5	Heis	
43	Mar. 30—Apr. 14	210	54	45, 47, 55, 59	S. & Z.	Prof. Serpieri, 1869 (202 + 62). This radiant appears to advance with the time, and is a con- tinuation of M 6, 7; lasting ten weeks?
	Apr. 25—May 25	202	52	{ M 7, 8?, M 6, 7 continued }	G. & H.	
44	Apr. 10-14	165	47	52, 56	S. & Z.	
	Apr. 15-30	160	49	M 8	Heis	
45	Apr. 14	240	55	58	S. & Z.	
46	Apr. 25	256	75	62	S. & Z.	
	Apr. 10—May 4	70	87	N 8?	G. & H.	Radiant, well defined near <i>Po- laris</i> .
	Apr. 1-30	267	84	N 7, 8	Heis	
47 (31)	Apr. 2—May 4	194	9	S 5, 6	G. & H.	Radiant elongated, 180° to 200°, R. A.; and 5° to 12° Dec. = S. 5, 6, 8?
48	Apr. 29—June 12	123	40	M G 4	G. & H.	
49 (53)	Apr. 19-20	152	22	M 3 Z	G. & H.	(Perhaps commencement of Y?) Elongated radiant?
50 (35)	May 25	280	54	74	S. & Z.	Well-defined radiant and shower; continuation of D G 1 possibly.
	Apr. 23—May 31	270	55	D G 2	G. & H.	
51	May 22—July 5	240	24	70, 83, 87	S. & Z.	A well-marked shower. Radiant centre at 239° + 23°, and probably multiple. Duration nine weeks. β <i>Herculis</i> in April; and pos- sibly distinct from position in corona for June.
	Apr. 12—June 30	240	25	Q 1, 2	G. & H.	
	May 1—June 30	237	19	Q 1, 2	Heis	
52	Apr. 27—June 30	305	81	N 9, 10	G. & H.	Radiant well defined.
	May 1-31	236	81	N 9, 10	Heis	

Epoch or Duration of Meteoric Shower.	Average Position of Radiant.		Name or Number of Radiant.	Authority.	Observations. (N.B. Radiant Area supposed to be 15° in Diameter. Radiants, "Z," by Mr. Greg, from Zezioli's Observations.)
	R.A. °	N.D. °			
53 (49) Apr. 29 — May 15	163	12	Y	G. & H.	{ (= M 3, Z ?) Radiant elongated, 160° to 167° R.A., and 75° to 70° Dec.
54 (47) Apr. 2 — May 4	195	7	S 5, 6, 8	G. & H.	{ Probably a continuation of S 4, 5. Radiant elongated?
May 1-31	202	9	S 6	Heis	
55 (62) May 1-31	325	55	B 1	Heis	{ Probably commencement of No. 62 or 65.
56 May 18 — June 14	273	34	68 (?), 75, 79	S. & Z.	{ Radiant elongated? centre at 270° + 32 (No. 68 doubtful.)
May 6 — June 30	280	29	W	G. & H.	
57 May 2 — June 20	312	21	W G	G. & H.	{ Radiant elongated.
June 28	302	27	82 ?	S. & Z.	
58 May 2 — June 9	206	39	66, 72, 78	S. & Z.	{ Small meteors; probably a mul- tiple radiant.
59 May 16 — June 2	235	43	67, 71, 77	S. & Z.	Ditto.
60 May 22-24	301	37	69, 73	S. & Z.	Ditto.
61 May 26	237	59	76	S. & Z.	Ditto.
62 (55) June 1-30	333	42	B 2	Heis	{ (= B 1 of Heis continued?) Doubtful.
63 June 7 — Aug. 12?	294	3	Q G	G. & H.	{ =Neumayer and Heis = radiant? Radiant, well defined at 294° + 7°. = 2 for July at 305° + 5.
June 1-30	292	15	W	Heis	
64 June 1-29	168	55	M G 3	G. & H.	{ Radiant rather uncertain, more observations needed.
65 July 18-31	320	62	{ 94?, 101, 102, 107, 114?, 127 }	S. & Z.	{ Multiple radiant. Radiant pre- cise.
June 11 — July 11	315	60	B 1	G. & H.	
July 1-31	317	62	B 3, 4	Heis	
66 June 28 — Aug. 3	270	51	{ 81, 90, 95, 97, 121, 131 }	S. & Z.	{ Confirmed in 1872 by Miss Her- schel at 274° + 57°. Requires further investigation; and possible connexion with Nos. 76 and 88, At 345 + 15 in 1871, A. S. Herschel. Radiant elongated.
67 June 29 — Aug. 24	330-345	14	T 1	G. & H.	
68 (80) June 19? — Aug. 4	304	40	{ 80?, 86, 88, 92, 109?, 112, 116, 117, 120, 126, 133 }	S. & Z.	{ Heis B. 6, doubtful. Clark at York gives the position at 315° + 42°.
July 10 — Aug. 20	310	47	B 4	G. & H.	
Aug. 15-31	304	59	B 6?	Heis	{ Radiant diffuse; elongated?
69 July 4	3	68	84	S. & Z.	
July 7 — Aug. 4	12	70	N 11	G. & H.	{ Serpieri; 11 July, 1868 = 200° + 55°, centre 216° + 57°? Confirmed by Zezioli's observations.
70 July 5	222	60	85	S. & Z.	
July 1-11?	210	55	M G 5	G. & H.	{ Heis, position doubtful.
71 July 2 — Aug. 16?	280	65	B 3	G. & H.	
July 8	288	64	89	S. & Z.	
Aug. 1-15	297	68	B 5	Heis	

	Epoch or Duration of Meteoric Shower.	Average Posi- tion of Radiant.		Name or Number of Radiant.	Authority.	Observations. (N.B. Radiant Area supposed to be 15° in Diameter. Radiants, "Z" by Mr. Greg, from Zezioli's Observations).
		R.A.	N.D.			
72 (51)	July 4 — Sept. 12	248°	18°	122, 124	Q. 3	Radiant rather diffuse, and elongated? Heis incorrect?
	July 1-15	262	12	Q 3	Heis	
73	July 4-11?	210	20	Q 4	G. & H.	Confirmed also by Zezioli's obs and reduced by Mr. Greg.
74	July 16	257	36	Q H	G. & H.	Observed by Prof. Herschel, July, 1871. Perhaps = Q 3.
75 (93)	July 24 — Aug. 11	330	88	115, 135?, 143	S. & Z.	Radiant well defined, close to <i>Polaris</i> . At 10° + 83 in 1871.
	July 28 — Sept. 10	359	90	N 12, 13	G. & H.	
	July 1 — Aug. 31	220	85	N 11, 12, 13, 14	Heis	
76	July 18 — Aug. 4	344	40	{ 98, 100, 103, 104, 106, 113, 123, 134 }	S. & Z.	Radiant multiple. Centre group near <i>η Pegasi</i> ; at <i>μ Pega</i> in 1872.
	Aug. 3-15	337	25	T G	G. & H.	
77	July 2 — Aug. 16	342-34		H	G. & H.	= γ_1 of Neumayer and Heis Southern Hemisphere radiant near <i>Fomalhaut</i> , observed by A. S. Herschel, 28 July, 186 Also seen in England, Aug. 9-1 1871.
78	July 11 — Aug. 7	7	50	{ 93, 111, 129, 130, 138 }	S. & Z.	From Zezioli's obs. (A. 9). Possibly with R 1, 2 of G. & H.
	July 4-11?	7	42	A 9	G. & H.	
79	July 28	174	55	118	S. & Z.	A well-defined radiant and meteoric shower, 1869-71. Maximum about 10th of August.
	July 29 — Sept. 6?	165	53	V	G. & H.	
80 (68)	July 21	309	40	109?	S. & Z.	Possibly connected with No. 68.
	July 4 — Aug. 22	315	31	B G	G. & H.	
81	Aug. 15-31	314	15	T 1	Heis	Heis, position probably incorrect
82	July 30 — Aug. 4	33	34	125, 132	S. & Z.	
83	July 9-21	242	68	91, 96, 108?	S. & Z.	Radiant well defined.
	July 12-31	245	64	B Z	G. & H.	
84	July 21	11	38	110	S. & Z.	Requires further investigation as to Epoch and duration.
	July 28 — Sept. 3? 1-15	36		R 1, 2	G. & H.	
85	Aug. 6-12	45	51	{ 137, 139, 142, 144 }	S. & Z.	N.B. The Perseids have an elongated radiant area extending from <i>Perseus</i> to <i>Cassiopei</i> = Comet III. 1862.
	Aug. 10-12	50-30	49-64		Serpieri	
	July 28 — Aug. 15	{ 50-25 44 }	{ 50-65 56 }	A 10	G. & H.	
	July 15? — Aug. 15	51	55	A 10, 11	Heis	
86	Aug. 6	254	37	136	S. & Z.	
87	Aug. 10	47	18	140	S. & Z.	
88	Aug. 10-11	3	17	(Tacchini)	S. & Z.	Possibly a pseudo-radiant of T and Perseids; or a commencement of T ₂ , 3.
	Aug.	355	18	T 1 a	G. & H.	
89	Aug. 22 — Oct. 15?	359	17	T 2, 3, (4?)	G. & H.	= Σ_2 of Neumayer and Heis, 346 + 3 for Sept.
	Sept. 1-30	352	10	T 2, 3	Heis	

	Epoch or Duration of Meteoric Shower.	Average Posi- tion of Radiant.		Name or Number of Radiant.	Authority.	Observations. (N.B. Radiant Area supposed to be 15° in Diameter. Radiants, "Z," by Mr. Greg, from Zezioli's Observations.)
		R.A.	N.D.			
90	Aug. 28	340	65	94, 145	S. & Z.	Exact duration uncertain. Radiant precise. Perhaps connected with No. 65 or 96.
	Aug. 6-31?	335	67	E 1	G.&H.	
91	Aug. 2 — Sept. 25	285	44	B 5	G.&H.	Well-marked shower; radiant well defined.
	July 29-31	276	36	122, 124	S. & Z.	
92	Aug. 15 — Sept. 30	38	63	A 12, 13, 14	Heis	G. Forbes, Cambridge, Aug. 10, 1868 = 33° + 59°.
13 (75)	Sept. 19 — Oct. 20	10	88	N 14	G.&H.	
	Sept. 1 — Oct. 15	100	85	N 15, 16, 17	Heis	Probably continuation of N 12, 13.
94	Sept. 6 — Oct. 12	55	33	147, 150, 155	S. & Z.	
	Oct. 14 — Nov. ?	46	27	R 3?	G.&H.	
	Sept. 1 — Oct. 15	48	34	R 1, 2, 3	Heis	
95	Sept. 1 — Oct. 15	306	62	B 7, 8, 9	Heis	
96	Sept. 5-20	319	53	146, 151	S. & Z.	
	Aug. 10 — Sept. 30?	335	52	E 2	G. & H.	Epoch requires further investigation, perhaps = No. 95. A well-marked shower in September.
97	Sept. 7-12	60	65	148, 149	S. & Z.	
98	Sept. 23	28	35	152	S. & Z.	
99	Sept. 6 — Nov. 23?	17	10	U	G.&H.	
100	Sept. 28 — Nov. 10	82	49	153, 162, 166	S. & Z.	Multiple radiant; centre about 82° + 50°. An important and well-defined meteoric shower, with tendency to advance with the time from 75° + 45° to 90° + 54°.
	Sept. 17 — Nov. 24	83-92	50-55	F 1, 2	G.&H.	
	Oct. 16-31	72	44	A 16	Heis	
101	Oct. 1-15	57	61	A 15	Heis	Tacchini, 21st Oct. 1867; radiant 74° + 25°. Maxm. 18-21 Oct. A well-marked shower; radiant precise at ' Orionis. Maxm. 18-20 Oct.
102	Oct. 5	240	63	154	S. & Z.	
103	Oct. 21	130	48	159	S. & Z.	
	Oct. 3-20	142	44	L G	G.&H.	
104	Oct. 13-21	84	21	{ 156, 157, 158, } 160	S. & Z.	
	Oct. 17 — Nov. 13?	90	15	O	G.&H.	
105	Oct. 23	111	29	161	S. & Z.	
106	Oct. 28	110	70	163	S. & Z.	
107	Oct. 16-31	205	85	N 18	Heis	
108	Oct. 16-31	334	56	B 10	Heis	
109	Oct. 16-31	23	40	P 1	Heis	
110	Oct. 18-29	283	43	B G 6	G.&H.	A doubtful radiant.
111	Nov. 10	70	20	165	S. & Z.	
	Oct. 25 — Nov. 21	64	18	R G 2	G.&H.	More observations required for this shower.
	Nov. 1-15	55	16	R 4	Heis	
						Mr. Backhouse 4-6 Nov. 1869, radiant = 54° + 16°; also observed at Greenwich 13th Nov. 1870 at 55° + 25°. Generally a well-marked shower at α Tauri.

C

	Epoch or Duration of Meteoric Shower.	Average Posi- tion of Radiants.		Name or Number of Radiant.	Authority.	Observations. (N.B. Radiant Area supposed be 15° in Diameter. Radiants, " by Mr. Greg, from Zezioli's Observations.)
		R.A.	N.D.			
112	Oct. 31 — Dec. 12	134°	6°	L H	G. & H.	
113	Nov. 9	61	42	164	S. & Z.	
114	Nov. 12-13	359	37	168, 170	S. & Z.	
115	Nov. 13-15	149	23	L	G. & H.	Leonids identical with Comet 1866.
	Nov. 13-15	148	24	L	Heis	
116	Nov. 23 — Dec. 9	291	53	D G 3	G. & H.	
	Nov. 1-15	279	56	D ?	Heis	
117	Nov. 13-14	33	40		Denza	{ Observed by Prof. Denza, 187; (Query pseudo radiant = A 16, P 2, 3 or R 3 ?)
118	Nov. 13-14	40	60	171	S. & Z.	
	Nov. 23 — Dec. 18	45	55	A 16	G. & H.	{ Connected with R 3? No. 1; probably a pseudo-radiant. R quires further investigation.
	Oct. 16 — Nov. 30	46	44	P 2, 3	Heis	
119	Nov. 12-17	117	38	169, 172	S. & Z.	
120	Nov. 30	17	48	176	S. & Z.	{ Radiant probably elongated. Sup- posed by D'Arrest and Wei to be connected with Biel's Comet.
	Sept. ? — Nov. 25 ?	7-23	54-61	A 14, 15	G. & H.	
	Nov. 1 — Dec. 15	17	60	A 17, 18, 19	Heis	
121	Nov. 10 — Dec. 9	142	36	{ 167, 173, 177, } 178, 181	S. & Z.	
122	Nov. 13	193	40	No. 122	G. & H.	{ Observed at Greenwich, 187; radiant near <i>Cor Caroli</i> . doubtful radiant.
123	Dec. 23	157	64	187	S. & Z.	
	Nov. 4 — Dec. 19	160	71	K G	G. & H.	{ Radiant elongated 140°, + 70° 170°, + 72°. Shower well marked
124	Nov. 19 — Dec. 15	123	84	N 19, 20	Heis	
125	Nov. 23-26	103	32	174, 175	S. & Z.	{ An important meteoric shower: maxm. 11th Dec. Radiant centre of <i>Geminorum</i> . Radiant at 105° + 30°, 12th Dec. 186 R. P. Greg and A. S. Hersch Mr. Wood at 100° + 34° in 186 Probably elongated 90° + 40° 105° + 28°. Aerolitic epoch.
	Nov. 26 — Dec. 30	100	33	G ₁	G. & H.	
	Dec. 1-15	112	39	M 9	Heis	
126	Dec. 9	154	26	182	S. & Z.	
127	Dec. 9-21	108	63	179, 180, 184?	S. & Z.	
128	Dec. 12	180	53	183	S. & Z.	
129 (7)	Dec. 23	157	64	187	S. & Z.	{ Possibly commencement of No. (Jan. 6.)
				? G ₂	G. & H.	

Supplementary Radiants.

130	Aug. 1-31	337	- 10	2 2	Heis	{ A southern radiant in the list Heis and Neumayer; observ in England 9-12 Aug. 1871.
131	Aug. 3-30	68	46	F G	G. & H.	
132	Aug. 3-15	55	26	R G 1	G. & H.	{ Reduced from the observations the Radcliffe Observatory at C ford in 1870-71. The Radiant also observed simultaneously.

In making or reducing meteor observations, note on a single night, or on two or three consecutive evenings, it is always best to map the results *at once*, and either to endeavour to determine any new radiant, or to correct the position of old-established ones; making use of this catalogue as a guide, rather than as an end. There being doubtless a tendency for particular meteor-showers to appear most strongly marked on certain special dates, it will thus be possible to determine the position of their radiant points more accurately than they are frequently at present known. Observations specially directed towards the supposed position of a radiant will also best show the shorter tracks, which are best calculated to determine the precise position of the radiant point of any particular meteor-shower: and the characteristic features of speed or duration, brightness, colour, and of the attendant sparks or streak of meteors belonging to different showers should at the same time be very carefully recorded, and considered in distinguishing the radiant points from which they probably diverged. The radiant V, and probably also T G (No. 78), seems to have appeared somewhat prominently only during the last two or three years; whilst the neighbouring radiant T 1 (No. 67), formerly a prominent feature, especially during the August period, and giving meteors considerably less rapid in their flight than the Perseids, have been less noticeable. Those meteor-showers, at present most clearly marked and contemporaneous with the greater 7-12th August period, are V; T G (78); N 12, 13; E 1 (90); B 3; H (77); B 4 (68); T 1 (67); and in mapping the meteors at that period it will be well to bear those radiants in mind whilst attempting to fix with any degree of precision the true radiant centre (probably in itself not a fixed or precise one) of the Perseids themselves. The series of well-marked and nearly contemporaneous meteor-showers from July to September, with radiant centres some 15° - 20° around, is near α Cephei, including E 1; E 2; B 1, and B 4 of Greg and Herschel; B 3, B 4, and B 5 of Heis, and mostly corroborated by the Italian observers, are deserving of more study, whether as to precise duration or exact position of radiant centres and connexions with each other; or as appertaining to a single multiple radiant, or to several distinct centres of radiation.

R. P. G.

Observations of Meteor Showers, supposed to be connected with Biela's Comet. By Prof. A. S. Herschel, F.R.A.S.

In a recent publication by Dr. Weiss* on the lately discovered connexion between the appearances of meteoric showers and the orbits of certain comets, a suggestion of some importance to observers of shooting stars is offered, to which the present year

* *Beiträge zur Kenntniss der Sternschnuppen*; Vienna Acad. Sitzungsbericht, vol. lvii. 1868.